From May 16 till September 4 the temperature in the sun's rays was constantly above the freezing-point (with exception of May 22, when this was not the case); on June 15 it reached 48°, on the 26th 54°, on July 5, 70°, and on August 11, 66°.

Observations at Pawlovsk, Russia, Lat. 59° 43'[1]

Date, 1881		Temp. in shade	Temp. in the sun's rays	Difference	Humidity
		°	°	°	%
Feb.	8	2	70	68	75
,,	18	21	88	67	74
,,	21	12	88	76	82
,,	24	12	91	79	76
,,	25	18	97	79	71
,,	28	9	91	82	73
March	14	20	106	86	73
,,	16	27	111	84	66
,,	22	20	109	89	65
May	25	68	128	60	39
June	8	82	140	58	40
,,	29	73	133	60	33
July	2	80	138	58	30
Aug.	10	64	131	67	72
Sept.	8	66	124	58	57
,,	18	62	124	62	66
Oct.	10	52	107	55	63
Nov.	4	32	86	54	78

It is clear that the influence of the sun's rays increases with higher latitude, because the sun in summer rests above the horizon.

Now we come to the main point, viz. the effect of the direct solar heat on vegetation in the northern regions.

In Novaya Zemlya the vegetation (consisting chiefly of herbaceous plants) is, in places exposed to the sun's rays (at the foot of mountains), like an arctic flower-garden, the surface of the soil not being covered with grass as is the case in the temperate regions. The flowers are here of a much greater size than the leaves. In this island, and even in Spitzbergen, the snow disappears in summer by the action of the sun from hills exposed to its light; but on Ben Nevis in Scotland, being a difference in latitude of more than 20°, the snow rests sometimes the whole year.

In the Tundra of Siberia, on the declivities of hills sheltered from the winds and exposed vertically to the sun's rays, the same herbaceous vegetation, with its large, splendid-coloured flowers, is observed (Middendorff, "Sibirische Reise," bd. iv. th. i. p. 733), but this is not the case in plains where the sunlight in its horizontal direction cannot have so much influence on the vegetation of the frozen ground; therefore these plains are in general really deserts, only covered with moss.

Insolation is also the cause of the rich vegetation in some parts of the mountains in the temperate zone (Alps, &c.).

Even in the most northern regions there can be a rich vegetation where the plants in sheltered localities are exposed to the sun. Parry ("Attempt to reach the North Pole") found the scurvy grass (*Cochlearia*) on Walden Island under 80° 30' N. lat. in such a luxuriant growth as he had never seen it before.

Middendorff observed, under 74° 30' N. lat., on the borders of Lake Taimyr in Siberia, on August 2, a temperature of 52° in the shade; but a heliothermometer under glass placed in the sun's rays stood at 104°; an uncovered one marked, in the sun, 70°. The pitch on his boat was not only melted by this temperature, but flowed (Middendorff, "Sib. Reise," p. 657).

But, as is the case also in lower latitudes, the greatest difference between the temperature in the shade and in the sun occurs in early spring. In June, Middendorff was travelling in the Stanowoi Mountains, and saw a rhododendron in full flower; when he was about to gather some flowers of this plant he found not only the roots, but even the stem, frozen hard in the soil. The temperature of the air was between 54° and 43°, but at night it was some degrees below freezing-point.

The assertion of some botanists that the contents of the cells, as soon as they are frozen, make the latter burst, thus causing the death of the plants, has been already refuted by Nägeli; but the important observations of Middendorff have showed clearly that the severest frosts of the Asiatic cold pole, by which the innermost parts of the trees are frozen as hard as iron, have little influence on the tissue when the cold becomes *gradually* more intense; only *when the temperature sinks suddenly below the freezing-point of the mercury* the wood splits with a thundering noise. These crevices have a disadvantageous influence on the vegetation of the tree in summer, because in these places the plant often begins to rot.

The trees rest in a frozen state till, in spring, the sun's rays reach the upper parts, and here vegetation is raised, though the roots and lower parts of the stem are still in a frozen state.

But the most interesting discovery on this subject was made by Middendorff under 69° 30' N. lat., on April 14, near the village of Dudino; notwithstanding the clear sky and incessant brilliant light of the sun, the temperature at mid-day ranged from −4° to −13°, yet before and after this time from −24° to −35°. While going over the glittering snow he was suddenly stopped by the sight of a willow-catkin peeping about an inch out of it. The catkin was wholly developed, yet the branch on which it was observed was, one or two inches down, solidly frozen; this was also the case with the other parts of the plant hidden under the snow (Middendorff, p. 653). Thus this little part of a branch was called to life, for some hours only, by the direct solar rays, in which it was thawed.

In the beginning of August, under lat. 74° 30', Middendorff found the soil exposed to the sun's rays heated to 86°, though the temperature about four inches below the surface was only 39°, and at the depth of about one foot the ground was constantly frozen (Middendorff, p. 666).

It is clear that plants in the high northern regions, when they vegetate, receive more warmth by insolation than is often supposed—1° by the direct solar light itself, and 2° by the heated surface of the ground. The snow and ice being melted by the sun, the necessary water and humid atmosphere never fail; even this is the cause of the luxuriant growth of grass on some places of the Tundra. The flowing water gradually communicates its warmth to the soil, and prevents also the nightly radiation.

All this is proof enough that, when the mean temperature in shade is known, this is not at all sufficient for a knowledge of the real temperature by which the vegetation of several plants is raised. What might have been the temperature in the tissue of the little branch and also in that of the willow-catkin, of which we have spoken? and this when the temperature in the shade was so many degrees below freezing-point.

In the temperate regions vegetation commences in spring, when the difference of temperature between night and day is greatest; in the high north this difference is often insignificant, because the sun rests above the horizon; but the temperature of the soil being at this time very much lower than that of the objects exposed to the sun's rays, even this great difference is the cause of the very rapid vegetation in sheltered localities and under the influence of the solar light.[1]

In conclusion we must remark that the facts thus briefly mentioned show how much a new system of bio-meteorological observations is wanted to ascertain the real quantity of warmth and sunlight necessary for the growth of plants, many of which are of the utmost importance in the life of man.

M. BUYSMAN

NEW ORGANIC SPECTRA[2]

THE absorption-spectra to be described were detected by means of the microspectroscope, and most of them are only fully visible in it, as the dispersion of the chemical spectroscope is too great for the detection of some of the very feeble bands. A binocular microscope provided with a substage achromatic condenser, to which are fitted two diaphragms, was specially made for this kind of work. Its objectives are so adapted as to enable both fields to be fully illuminated when any power up to the one-eighth is used. The left-hand tube is used as a "finder," and as a means of getting any required portion of the object into the centre of the field so that its spectrum may be obtained in the spectrum eyepiece of the right-hand tube. In this way the various portions of a very small bit of tissue or organ may be readily differentiated from each other and

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[1] *Annalen des Physikalischen Central Observatoriums*, St. Petersburg, 1881.

[1] In 50° N. lat., on the banks of the Amur River, where the situation with regard to the ground-ice in spring is the same as in the Taimyr country, *Nasturtium* and *Calamagrostis* plants were observed to grow about half a foot every day (see *Beiträge zur Kenntniss des Russischen Reiches*, Band xxiii. pp. 547, 617).

[2] Abstract of a communication made to the Physiological Society, at the meeting on December 13, 1884 (and published in *Proceedings* No. iv. 1884), by Dr. C. A. MacMunn.

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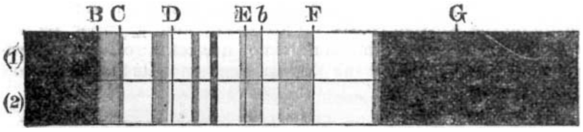
their spectra observed. Moreover, by the use of the iris diaphragm, which is placed below the substage condenser, the marginal part of the field can be readily cut off. Another piece of apparatus is indispensable, namely, the *compressorium*, as by its aid the section is squeezed out thin enough to allow the spectrum to be observed.

No reagent whatever is required for the detection of the spectra to be described, so that the substances present cannot be altered in any way.

Myohæmatin.—Physiologists have accepted Kühne's statement that muscle owes its colour to hæmoglobin, but although the majority of voluntary muscles do owe their colour to it, it is accompanied by myohæmatin in most cases, and sometimes entirely replaced by it, while in other cases it entirely replaces myohæmatin. The *heart* muscle of every vertebrate animal which I have examined yields myohæmatin, which gives a very beautifully defined spectrum totally distinct from any decomposition product of hæmoglobin, *e.g.* methæmoglobin, acid or alkaline hæmatin, or hæmatoporphyrin. All one has to do in order to detect myohæmatin is to cut off a bit of heart muscle, put it while fresh in the compressorium, press it down, and observe the spectrum. *No reagent whatever is required.* The spectrum consists of three bands, two of which are very narrow, and persist after the hæmoglobin bands have gone when the tissue has been squeezed out to great thinness in the compressorium. The bands have been missed by other observers simply because when the oxyhæmoglobin bands are well marked they cover and are merged into the myohæmatin bands. The first band of myohæmatin occurs just before D, the next two (of great narrowness) are placed between D and E, and two other faint bands may be present nearer violet, of which the first covers E and *b*, and the other is between *b* and F, close to latter line. Their wave-lengths are: 1st band λ 613–596·5, 2nd band λ 569–563, 3rd band λ 556–549 (heart of dog), and they have been measured in all cases with the same result. I find myohæmatin in the heart muscles and some voluntary muscles of the following mammals:—Man, dog, cat, rabbit, guinea-pig, hedgehog, sheep, ox, pig, rat and hare. In birds. in pigeon, owl, duck, goose, turkey, and fowl. In reptiles: in green lizard, common ringed snake, and fresh-water tortoise. In Batrachians: in toad, frog, salamander, axolotl, and tree-frog. In fishes: in herring, mackerel, tench, roach, eel, plaice, whiting, and codfish.[1] But it is also found in Invertebrates, in which I first detected it. It is found in the muscle from thorax and in leg muscles of the following insect genera:—Dytiscus, Hydrophilus, Lucanus, Cerambyx, Creophilus, Staphylinus, Geotrupes, Carabus, Coccinella, Musca (three species), Tipula, Gryllus, Blatta, Vespa, Apis, Bombus, Pieris, Ennomos, &c. It also occurs in the cephalo-thoracic muscles of spiders, in the heart of the crab, lobster, and crayfish (and not in their voluntary muscles); in the heart and buccal muscles of Arion, Limax, Helix, and other pulmonate mollusks, while in other mollusks it appears to be replaced by hæmoglobin in the pharyngeal muscle, as Prof. Lankester has found out



1.—Myohæmatics from Alar muscles of *Vespa vulgaris*. 2.—Myohæmatics from heart of *Limax variegatus*.

Two attempts have been made to isolate it. In the first it was got out of the muscle by digesting in pepsine solution, and was slightly changed in the process; in the second it was got out of the frozen heart muscle of a rabbit by pressing out the plasma;[2] here it was mixed with traces of hæmoglobin, but could be differentiated from it: hence it probably occurs in muscle *plasma* like muscle-hæmoglobin.

Histohæmatin.—This name has been given by me to a cla s of pigments or modifications of the same pigment, which are found widely distributed in the animal kingdom. Myohæmatin belongs to them, as can easily be shown. They are found in Mollusks, Arthropods, Echinoderms, and, modified peculiarly, in Cœlenterates. The bands are carefully measured and compared with spectra yielded by various organs and tissues of Vertebrates, and no difference is found between those of Vertebrates and Invertebrates. In order to see these spectra in the higher animals the blood-vessels are washed out with salt solution thoroughly, and then the organs and tissues examined in the manner described. It is not possible to go into this subject in an abstract, as the facts are too numerous to be compressed into such a small space; it will suffice to say that the histohæmatins are respiratory pigments, as can be proved by oxidising and reducing them in the solid organs. Their bands occupy almost the same place as those of myohæmatin, except that the second and third bands of the myohæmatin spectrum appear compressed into one in some cases.

Myohæmatin itself is also undoubtedly a respiratory substance.

Spectrum of the Supra-renal Bodies.—In the supra-renals of man, cat, dog, guinea-pig, rabbit, ox, sheep, pig, and rat, the medulla gives the spectrum of hæmochromogen, while the cortex shows that of a histohæmatin. Wherever we find hæmochromogen in a vertebrate body it is probably excretory, and I have only found it in the bile and in the liver. Hence, and owing to the remarkable darkness of its bands in the medulla of the adrenals, it must be looked upon here as excretory; if so, the function of the adrenals must be (at least in part) to metamorphose effete hæmoglobin or hæmatin into hæmochromogen; if from disease, or after removal, as in Tizzoni's experiments, the effete pigment is not removed, pigmentation of skin and mucous membrane may take place. The presence of taurocholic acid in the medulla (Vulpian), the resemblance in the structure of the adrenals to that of the liver, and the large lymphatics, with the well-known results of disease of the adrenals in Addison's disease, all go to show that an active metabolic process is taking place in them, and I believe I am justified in concluding that they have a large share in the downward metamorphosis of effete colouring matter, and that these observations will help to throw some light on Addison's disease.

SOUTH GEORGIA

SOME interesting particulars of the geography, climate, &c., of the island of South Georgia have recently been published by the members of the German Expedition which sojourned in 1883 at the island. They are of the more interest as no scientific expedition had previously visited the island, of which but little therefore is known. The Expedition, in command of Dr. Schrader, took up their quarters at Moltke Hafen, in Royal Bay, which is from four and a half to five miles wide and from six to eight miles long; here observations were made from September 15, 1882, until September 3, 1883, when the Expedition left in a German gunboat. The 8472 observations made during this period on the temperature, air-pressure, moisture, wind, &c., are of great importance.

The island is by its position (54° 31′ S. lat. and 36° 5′ W. long.) not an Antarctic island in the strict sense of the word, but its appearance stamps it as such—Royal Bay being surrounded by mountains, with enormous glaciers from 900 to 1200 feet in height, which further inland rise to 6000 or 7000 feet. This circumstance may give some idea of the climate, and it is therefore not surprising to learn that the mean temperature of the whole period of observation was only 35° F.; for February, the warmest month, 42°, and for the coldest (June) 26°·6. No single month was free from frost, and 30 per cent. of the hours of observation showed a temperature below freezing-point. In July the minimum-thermometer registered 26°·2, and in February the maximum-thermometer 57°·2, the range of temperature amounting to 31°. Clear days occurred in the winter only, the total number being 8; whereas the total of cloudy days was 127; the latter were less frequent in July and August. During December not a single day was clear, and the total number of hours of clear sky was only 269, against 3302 which were cloudy, viz. 38·9 per cent. of the total. Consequently there was much rain and snow, particularly in November and December, which had only one dry day each. Most snow fell in March and least in May. Even the warmest month, February, had 13 days with snow, while the coldest, June, had four days with rain. It hailed on 19 days, principally in December; there were 75 days of fog, but it did not last long. As regards winds and storms, the observations of the Expedition seem to indicate that the neighbourhood of Cape Horn is not quite so stormy as is generally believed. At South Georgia there were

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[1] These being all the vertebrate animals which I have yet examined.

[2] After suitable precautions had been taken to exclude the influence of the blood, as fully described in the demonstration.

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